



1995-96 KIRIS OPEN-RESPONSE ITEM SCORING WORKSHEET

Grade 11 — Science Question 1

The academic expectations applied in this item include:

2.1 Students understand scientific ways of thinking and working and use those methods to solve real-life problems.

2.3 Students identify and analyze systems and the ways their components work together or affect each other.

The core content assessed by this item includes:

Process

- Scientific investigations are designed and conducted.
- Historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.
- Scientific explanations must adhere to criteria.

Content

- Motions and Forces
 - * Objects change their motion only when a net force is applied. Laws of motion are used to predict and/or calculate the effects of forces on the motion of objects.

1. Liquids Moving Against the Pull of Gravity

A straw can be used to draw liquid from a container to your mouth if you apply a suction force on the straw. Suppose you stood on a cliff eight meters high with a very long straw and tried to drink from a container at the bottom of the cliff.

- Describe four or more variables that might affect the outcome of this experiment and explain how.
- Describe four or more real-life examples from physical and/or living systems where liquids are moved against the force of gravity.

SCORING GUIDE

Score	Description
4	A. Student describes four or more pertinent variables and explains how each would affect the outcome of the experiment. B. Student describes four or more real-life examples where liquids are moved against the force of gravity.
3	A. Student describes three or more pertinent variables and explains how each would affect the outcome of the experiment. B. Student describes three or more real-life examples where liquids are moved against the force of gravity.
2	A. Student describes two or more pertinent variables and explains how each would affect the outcome of the experiment. B. Student describes two or more real-life examples where liquids are moved against the force of gravity.
1	A. Student describes one or more pertinent variables and explains how each would affect the outcome of the experiment. And/Or B. Student describes one or more real-life example(s) where liquids are moved against the force of gravity.
0	Response is incorrect or irrelevant.
Blank	Blank/no response.

Examples of Pertinent Variables:

Height of cliff: Higher more difficult to drink	Strength of person drinking
Diameter of straw: Wider is more difficult	Temperature
Strength of material in straw: Weak and it may collapse	
Density of liquid: Higher density is more difficult	
Altitude of location: Higher altitude is more difficult	
There is more gravitational pull on the liquid as the mass of the liquid inside the straw increases.	

Examples from Physical/Living Systems:

Water movement in plants	Water from wells
Oil rigs	Volcanoes erupting
Basement toilet flushing	Geysers
Blood	Evaporation
Water in a city water system moving over hills	Tidal waves
Rivers and waterfalls are not acceptable	Regurgitation

Note: At sea level the maximum height water would rise in a tube that has a perfect vacuum is 10.3 meters. This is 2.3 meters above the 8-meter high cliff. 2.3 meters equals 7.5 feet. If a person's mouth is more than 7.5 feet above the cliff top, they could not drink from the straw.



KIRIS ASSESSMENT ANNOTATED RESPONSE

GRADE 11 SCIENCE

Sample 4-Point Response of Student Work

Student describes four variables, i.e. type of liquid, diameter of straw, length of straw, and the amount of suction force.

Student describes four real-life examples, i.e. in plants, in our body, water faucets in our home, and water pumps in a well.

Student demonstrates an ability to design investigations by clarifying the variables.

Student demonstrates an understanding that scientific knowledge influences the design of investigations.

a) There are several variables that might affect the outcome of this experiment. One such variable is the type of liquid in the container. It would require much more force to draw a thick liquid, like coke, than to draw up a thinner liquid like water. The type of liquid plays a key role in the amount of force used as suction. A second variable in this experiment is the size and length of the straw. For example a straw with a small diameter requires more suction force than a straw with a larger diameter does. If you have ever been to a restaurant you might have noticed that it is much easier to drink out of a larger straw than a very small straw with a small diameter. The length of the straw is also an important variable. If you were on a cliff that was eight meters high you would need a straw of at least eight meters high as well, maybe more. Most straws are only a few inches long and are not designed to apply this form of suction force. The liquid would have quite a distance to travel before it reached your mouth. This would require a very strong force of suction. Not only would this force have to be strong but continuous. The first time you stopped sucking to breathe all of the liquid that has begun the long journey up goes back down into the container. Thus the size and length of the straw play an important role as to the amount of suction. This leads directly to the fourth variable which is the amount of force. This experiment requires a tremendous amount of suction force that no human mouth could fulfill. In a device that acts as lungs sucking air up through the straw causing the liquid to rise. This liquid could then be filtered into a container at the top of the cliff with a normal sized straw waiting. b) There are many real-life examples in which liquids all move against the force of gravity. One example is in plants. Plants use their roots as a suction force to pull water up from the ground. A second example is the pumping of blood throughout our body. Gravity pulls the blood downward toward the ground and our legs and feet, but a suction force pulls the blood upward again to return to the heart. A third example is the water we receive through the faucets in our homes. When a faucet is turned on it uses a suction force to pull the water from the pipes into your home and out through the faucet. A water pump on a well works much the same way. It uses it's suction force to pull water from deep within the well against the force of gravity.

Student explains how each variable might affect the outcome.

Student demonstrates an application of scientific ways of thinking and working and uses those methods to solve real-life problems.

Student demonstrates an application of systems and the ways their components work together or affect each other.

Student demonstrates an understanding that scientific explanations must be based on scientific knowledge.

Student demonstrates a knowledge that objects change their motion only when a net force is applied. Laws of motion are used to predict and/or calculate the effects of forces on the motion of objects.



KIRIS ASSESSMENT ANNOTATED RESPONSE

GRADE 11 SCIENCE

Sample 3-Point Response of Student Work

Student describes three variables, i.e. thickness of the liquid, width of the straw, and the temperature.

Student explains how each variable might affect the outcome.

Student describes three real-life examples, i.e. the human circulatory system, water in home plumbing, and oil in a car motor. The fourth example is incorrect.

Student demonstrates an ability to design investigations by clarifying the variables.

This experiment may be affected by many different outcomes. Depending on the thickness of the liquid would make a great difference in the amount of time it takes the liquid to travel up the straw. Also the width of the straw would make a difference in that if you had a large straw you would have to apply greater suction because you are trying to draw more liquid up through the straw. You would have to be consistent with the amount of liquid you were trying to draw from the container also, because if you had different amounts of liquid then the experiment would be off. Another factor in doing this would be the temperature outside. If the temperature was high the liquid would be likely to move faster than if it were cool because the warm molecules would be moving around faster and this would cause easier flow. Many situations in life also cause liquids to move against the pull of gravity other than just a straw. For example, your circulatory system in your body faces this problem every day when transporting your blood. Water flowing from the ground to our houses every day also faces this. Oil moving through your car motor also has to face this because the oil pan is at the bottom and the oil has to flow up into the motor when you start your car. Also, some rivers face this problem when they flow.

Student demonstrates an application of scientific ways of thinking and working and uses those methods to solve real-life problems.

Student demonstrates an application of systems and the ways their components work together or affect each other.

Student demonstrates an understanding that scientific knowledge influences the design of investigations.

Student demonstrates an understanding that scientific explanations must be based on scientific knowledge.

Student demonstrates a knowledge that objects change their motion only when a net force is applied. Laws of motion are used to predict and/or calculate the effects of forces on the motion of objects.



KIRIS ASSESSMENT ANNOTATED RESPONSE

GRADE 11 SCIENCE

Sample 2-Point Response of Student Work

Student describes four variables, i.e. using the same liquid, the size of the straw, the weather, and the altitude.

Student explains how two variables might affect the outcome.

Student demonstrates some application of scientific ways of thinking and working and uses those methods to solve real-life problems.

Student describes four real-life examples, i.e. blood in human bodies, evaporation, water in home plumbing, and liquids in factories. A more correct concept is that evaporation is a gas rather than a liquid opposing gravity.

a) One variable that might affect the outcome of the experiment would be if you used the same liquid everytime or if you changed it everytime. Different liquids might move faster or slower than others coming up the straw. The straw might change the outcome. If you have different sizes of straws how fast or slow the liquid moves will be affected. The weather might also affect the experiment. The last thing that might affect the outcome of the experiment would be the altitude that you are at while performing the experiment.

b) Some real-life examples of liquids moving against the force of gravity would be blood pumping to your brain, evaporation, water moving through pipes coming up into your house and in factories where they have liquids moving every which way.

Student demonstrates some application of systems and the ways their components work together or affect each other.

Student demonstrates some ability to design investigations by clarifying the variables.

Student demonstrates some understanding that scientific knowledge influences the design of investigations.

Student demonstrates some understanding that scientific explanations must be based on scientific knowledge.

Student demonstrates some knowledge that objects change their motion only when a net force is applied. Laws of motion are used to predict and/or calculate the effects of forces on the motion of objects.



KIRIS ASSESSMENT ANNOTATED RESPONSE

GRADE 11 SCIENCE

Sample 1-Point Response of Student Work

Student explains how one variable might affect the outcome.

With an extremely long straw it would be impossible to suck liquid from a container up to your mouth with suction alone. The pressure in the straw becomes less than the pressure pushing down on the surface of the liquid so the liquid rises to the low pressure area inside the straw, under normal conditions. But with an extremely large straw it would take a lot of suction to lower the pressure or extra pressure would have to be exerted on the surface of the liquid to push it up. The altitude, air pressure, size of standard viscosity of the liquid would all effect the experiment making them variables. In our body blood flows away from the force of gravity by an intricate system of valves and the pumping of the heart.

Student describes one real-life example, i.e. blood in human bodies.

Student describes four variables, i.e. the pressure difference between the inside and the outside of the straw, altitude, air pressure, and the viscosity of the liquid.

INSTRUCTIONAL STRATEGIES

Liquids Moving Against the Pull of Gravity

Students investigate the variables that affect the flight of a paper glider. Students predict the effect of altering one variable and then verify or refute the prediction.

Students research how a barometer measures atmospheric pressure, compare a mercury and a water barometer, and explain (in writing) how drinking through a straw is similar to a barometer.

Students lower a glass (mouth downward) into a large container of water and observe the level of the liquid inside the glass as the glass is lowered into the large container of water. Students explain (in writing) why the volume of trapped air becomes smaller.

Students hold a bottle under water until it is completely filled, then lift the bottle (mouth downward) out of the water until only its mouth is below water. Students explain (in writing) why the water does not run out and what causes the gap that appears between the water and the highest part of the bottle (its bottom).

Students heat a metal can with the top removed to remove some of the air, put the top back on the can as it is removed from the heat source, then let it stand at room temperature. Students explain (in writing) what they observe and why it happened.

Students practice scoring open response items by using released KIRIS items, released scoring guides, and photocopied student responses.